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NUMBER THEORY.

215. Proposed by R. D. CARMICHAEL, Indiana University.

Find one or more values of n such that a polygon of n sides shall have the number of its diagonals equal to the cube of an integer.

SOLUTION BY WALTER C. EELLS, U. S. Naval Academy.

Since the number of diagonals of an n -sided polygon is $\frac{n(n-3)}{2}$, this is equivalent to the problem: find solutions in integers of $n^2 - 3n = 2k^3$. By the aid of a table of squares it is easily found that the only values of n less than 1,000 satisfying this equation are 9 and 128, for which $k = 3$ and 20 respectively, the number of diagonals being 27 and 8,000.

216. Proposed by ELIJAH SWIFT, University of Vermont.

If p is a prime > 3 , show that $\sum_{a=1}^{a=p-1} 1/a \equiv 0 \pmod{p^2}$, where $1/a \equiv x$, if $ax \equiv 1 \pmod{p^2}$.

SOLUTION BY THE PROPOSER.

Referring to my solution¹ of algebra problem number 385, I proved that

$$A_{p-2} \equiv 0 \pmod{p^2}, \text{ where } A_{p-2} \equiv 1 \cdot 2 \cdot 3 \cdots p-2 + 1 \cdot 3 \cdot 4 \cdots p-1 + \cdots.$$

Hence,

$$A_{p-2} \equiv (1 \cdot 2 \cdot 3 \cdots (p-1)) \sum_{a=1}^{p-1} \frac{1}{a}.$$

Suppose that

$$1 \cdot 2 \cdot 3 \cdots (p-1) \equiv -1 + A \cdot p \pmod{p^2}.$$

Then

$$A_{p-2} \equiv \sum_{a=1}^{p-1} \frac{-1 + Ap}{a} = \sum_{a=1}^{p-1} \frac{-1}{a} + pA \sum_{a=1}^{p-1} \frac{1}{a}.$$

But

$$\sum_{a=1}^{a=p-1} \frac{1}{a} \equiv \sum_{a=1}^{a=p-1} a \pmod{p} \equiv 0,$$

since

$$A_{p-2} \equiv 0 \pmod{p^2} \sum_{a=1}^{a=p-1} \frac{1}{a} \equiv 0 \pmod{p^2}.$$

NOTES AND NEWS.

EDITED BY W. DEW. CAIRNS.

Miss MARIE GUGEL, formerly teacher of mathematics in the Toledo, Ohio, high school, is now supervisor of high schools in Columbus. She is secretary of the mathematics section of the Central Association of Science and Mathematics Teachers.

Mr. FORREST R. BAKER, assistant in mathematics at the University of Michigan, died December 6, following an operation for appendicitis.

¹ Volume XXI, page 157, May, 1914.

Professor L. C. KARPINSKI has been promoted to a junior professorship of mathematics in the University of Michigan.

Mr. F. A. FORAKER, of the University of Pittsburgh, contributes to *Education* for December, 1914, an article on "The relation of the symbols of mathematics to the elements of the problems."

At the University of Oklahoma Associate Professor F. C. KENT has resigned and Mr. H. B. GOSSARD, of the Johns Hopkins University, has been appointed to an instructorship in mathematics.

The *Bollettino di bibliografia e storia delle scienza matematiche* for the last quarter of 1914 contains an Italian translation of Professor E. J. WILCZYNSKI's paper on "Some general aspects of modern geometry" which appeared in the *Bulletin of the American Mathematical Society* for April, 1913. The translation is preceded by a brief appreciative account of Professor Wilczynski's fundamental work on projective differential geometry.

An article in the October, 1914, number of the *Bulletin* of the Society for the Promotion of Engineering Education, entitled "What a technical education costs," gives the average annual expense of 65 students at the Massachusetts Institute of Technology. This amounted to \$616.39 for students from a distance and \$327.65 for students living at home.

School Science and Mathematics for November and December, 1914, printed a paper on "Some observations on the study and teaching of mathematics in Germany," read by Professor GORDON N. ARMSTRONG, of Ohio Wesleyan University, before the April meeting of the Ohio Teachers of Mathematics and Science.

In the *Mathematical Gazette* for October, 1914, Mr. W. H. MACAULAY presents the results of an investigation of the problem of dissecting two given rectilineal figures of equal areas, by straight lines, so that the parts of either will fit on the other. The simplest case is that in which the triangles ABC and $A'B'C'$ have a pair of equal sides, AB and $A'B'$, and do not differ too much in shape. They can be divided by a three-part and by a four-part dissection, the former being accomplished by joining E and D , the mid points of AC and BC , to F in AB by lines equal to half of $B'C'$ and $A'C'$ respectively; and analogous lines in triangle $A'B'C'$. With the aid of these two fundamental cases Mr. Macaulay establishes other cases, such as the dissection of any given pair of triangles of equal areas (not differing too much in shape) by a four-part and by a seven-part dissection; of a rectangle and square of equal areas; of a quadrilateral and parallelogram of equal areas, etc.

A recent letter from PROFESSOR CAJORI includes the following interesting notes:

A "Junior Encyclopedia Britannica" is now in preparation. The mathematical articles will be prepared by PHILIP E. B. JOURDAIN, of Girton, near Cambridge. Only the first two volumes will appear until the war is over, but these will contain the two long articles "Arithmetic" and "Algebra," as well as several shorter articles. Jourdain's idea is to treat every mathematical subject historically. For example, instead of attempting to define algebra, which word has meant different things at different times, the plan is to show that algebra grew out of such and such problems and took on such and such meanings, and to give an idea also of the modern, advanced work.

Mr. Jourdain has been working for some time, on a "History of Mathematical Thought," to be published by George Bell, of London. It will contain a very thorough treatment of the development of the leading conceptions of mathematics, such as limit, continuity, etc. The book will carry the subjects down to modern times and will not go into great details about purely technical advances. Somewhat new will be the stress laid on the influence of Zeno on the form which Greek mathematical thought took, also the unconscious and illogical way in which negative, irrational and imaginary numbers were introduced. A good deal of space will be devoted to the modern work and the principles of mathematics.

The Open Court Publishing Co. will shortly bring out two books translated and annotated by Mr. Jourdain. One is a supplementary volume to the English Mach's *Mechanics*, giving the additions made by Mach to the latest German edition. The other book is a translation of Georg Cantor's papers on transfinite numbers in volumes XLVI and XLIX of the *Mathematische Annalen*.

Periodico di Matematica per l'insegnamento secondario, edited by Professor Giulio Lazzeri, is published bi-monthly at Livorno, Italy, and the *Supplemento al Periodico di Matematica*, under the same editorship, appears monthly from November to July inclusive. The former journal is now in the thirtieth year of publication, and the *Supplemento* in the eighteenth year.

The *Periodico* is intended to meet the scholarly demands of the teachers of mathematics in the secondary schools, and also the needs of university students of mathematics and physics. The *Supplemento* is more elementary in character, and aims to excite even in students in the secondary schools a love for the study of mathematics and physics. A somewhat unique feature of the latter journal is a continuous series of prize problems, the competitors being any students of mathematics and physics in the secondary schools, and the prizes being books on mathematics.

The November, 1914, issue (48 pages) of the *Periodico* contains the following articles, all in Italian: C. MINEO, "On the concept of a real number and upon an elementary theorem concerning such numbers"; D. KRYJANOVSKY, "Upon maxima and minima of plane figures (continuation)"; G. LAZZERI, "Static moments, moments of inertia, and moments of higher order (continuation)"; E. PICCIOLI, "The second hypersphere of Lemoine, etc."; G. CANDIDO, "The

solution of the equation

$${}^{2k+1}\sqrt{A} + {}^{2k+1}\sqrt{B} + {}^{2k+1}\sqrt{C} = 0,$$

and "On the equation, $\sum_1^k x_i^2 = y^p$ ". There also appears a review (less than a page) of the new 5-place logarithmic tables, 56 pages, by Professor E. MOUZIN, published by the Fratelli Bocca in Rome.

The November, 1914, issue of the *Supplemento* contains the following articles: S. CATANAIA, "On the solution of literal irrational equations"; G. ASCOLI, "Note on elementary geometry". There is also discussion of a number of problems. The 134th prize problem proposed by G. Ascoli is as follows:

Determine upon the side BC of a triangle ABC a point U which is such that given U' and U'' the projections of U upon AC and AB respectively, the right lines AU, BU', CU'' , shall concur in a point. Demonstrate that if V and W are points on CA and AB , defined in an analogous manner, the right lines AU, BV, CW concur in a point.

The initial number of the *Proceedings of the National Academy of Sciences* contains three mathematical articles, as follows: "Recent progress in the theories of modular and formal invariants and in modular geometry," by L. E. DICKSON; "The synthesis of triad systems," by H. S. WHITE; "The ϕ -subgroup of a group of finite order," by G. A. MILLER. Professor E. H. MOORE, University of Chicago, is the mathematical editor of this journal, which is expected to appear monthly, the first issue being that for January, 1915.

It is announced that a joint session of the American Mathematical Society, the American Astronomical Society and Section A (Astronomy and Mathematics) of the American Association for the Advancement of Science will be held at the University of California on Tuesday, August 3. Addresses will be made by Professor C. J. KEYSER, of Columbia University, on "The human significance of mathematics," and by Dr. G. E. HALE, of Mount Wilson Solar Observatory, on "The work of a modern observatory."

A monument to Professor ENRICO BETTI has been erected in the suburban cemetery at Florence. The monument was designed by Professor Ristori of the Accademia di Belle Arti of Florence, and the bronze work was made under the direction of the sculptor and architect, Professor Arcangeli of Florence.

The address by Dr. FRANK SCHLESINGER, of the University of Pittsburgh, as vice-president and chairman of Section A of the American Association for the Advancement of Science at Philadelphia, appears in *Science* for January 22, the subject being "The object of astronomical and mathematical research."

School Science and Mathematics for February prints an address on "Mathematics and life—the vitalizing of secondary mathematics," delivered by Professor R. D. CARMICHAEL before the Kansas Association of Mathematics Teachers in November, together with the attendant discussion by W. T. STRATTON, of Kansas State Agricultural College.

The *Mid-West Quarterly*, a journal owned and controlled by the University of Nebraska, contains an article in the October, 1914, issue, by Professor E. W. DAVIS, on "Charles Peirce at Johns Hopkins." He was the son of the Harvard mathematician, Benjamin Peirce, and was said by Professor Sylvester to have been "a far greater mathematician than his father," though his activities in other fields were many and varied, especially in the domain of logic.

A lecture by Professor E. W. HOBSON on "John Napier and the Invention of Logarithms" has been published by the Cambridge University Press.

An article by L. C. KARPINSKI reprinted from the *Journal of Education*, Boston, on the tests by Cliff W. Stone and S. A. Courtis for determining standards of efficiency in the fundamental operations of arithmetic, is of interest in the line of recent critical examinations of the schools with a view to some definite and precise knowledge of their achievements and shortcomings.

In the September-October number of *Rendiconti del Circolo Matematico di Palermo* appears a paper on "Some properties of closed continuous curves," by Professor ARNOLD EMCH. The November-December number contains a paper on "Birational transformations of the cubic variety in four-dimensional space," by Professor VIRGIL SNYDER, and one on "Algebraic and transcendental numbers," by Professor G. N. BAUER and Dr. H. L. SLOBIN.

School and Society is the name of a new weekly journal edited by Professor J. McKEEN CATTELL and printed by the Science Press at Lancaster, Pa. The scope of this journal is broad. To quote from the prospectus: "The journal will follow the general lines that have made *Science* of service in the sciences, coöperating with publications in special fields, aiming to become the professional journal for those engaged in the work of our lower and higher schools, and to be of interest to the wider public for whom education is of vital concern. It will emphasize the relations of education to the social order, scientific research in education and its applications, freedom of discussion, and reports and news of events of educational interest."

The committee of the New England Association of Mathematics Teachers appointed to consider the status of secondary mathematics made a preliminary report at the meeting of December 5, 1914, at which time addresses were made by Superintendent MORRISON, of New Hampshire, and Commissioner SNEDDEN, of Massachusetts. The committee has had extended correspondence with Commissioner Snedden which is likely to be published in the near future.

The committee has recently organized subcommittees on: The status of algebra; The practicability of an introductory composite course; The training of teachers of mathematics; School programs; Psychological aspects of the subject; and Mathematics for girls. A syllabus for each topic is in preparation, and correspondence with persons interested would be welcome. See Question 24 under QUESTIONS and DISCUSSIONS in this issue.

The prospectus of *The University of Chicago Science Series* states that: "The volumes of the series will differ from the discussions generally appearing in technical journals in that they will present the complete results of an experiment or series of investigations which have previously appeared only in scattered articles, if published at all. On the other hand, they will differ from detailed treatises by confining themselves to specific problems of current interest and in presenting the subject in as summary a manner and with as little technical detail as is consistent with sound method. They will be written not only for the specialist but also for the educated layman. The size of the volumes will range from fifty to one hundred and fifty pages."

The mathematical publications thus far planned or in preparation are: "Finite collineation groups," by Professor HANS BLICHFELDT, of Stanford University; and "Linear integral equations in general analysis," by Professor E. H. MOORE, of the University of Chicago. The editors of this series are Professors E. H. MOORE, J. M. COULTER, and R. A. MILLIKAN.

The meeting of the Michigan Schoolmasters' Club will be held at Ann Arbor, April 1, 2, and 3, 1915. The program of the mathematics section of the Club will consist entirely of short discussions on practical phases of the teaching of high school mathematics. On Thursday, April first, the teachers will meet at a luncheon at Newberry Hall, Ann Arbor, and the papers will be presented at the same place. The discussion on Thursday will center about the two topics: Practical applications of high school mathematics, and Correlation between mathematics and other branches and correlation of the various mathematical disciplines. Papers will be presented on the correlation between arithmetic and algebra, between algebra and geometry, and between mathematics and physics. On Friday the discussion will center about the two topics: The teaching of algebra, and The teaching of geometry.

A letter from Professor Bôcher calls attention to the fact that the holders of the Benjamin Peirce instructorships at Harvard University may not "pursue courses for higher degrees" as stated in the February number of the MONTHLY, but that as a rule the incumbents will hold the degree of doctor of philosophy. He states that the appointees for 1915-16 are Dr. EDWARD KIRCHER and Dr. G. A. PFEIFFER, both of whom received the degree of Ph.D. in 1914, the former at the University of Illinois, and the latter at Columbia University.

Mr. Bradbury, whose death was announced in the February issue, was head master of the Cambridge Latin School and not of the Boston Latin School, as stated.